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26 November 1969

Materiel Test Procedure 3-3-510
U. S. Army Armor and Engineer Board

U. S. ARMY TEST AND EVALUATION COMMAND
COMMON SERVICE TEST PROCEDURE

WEAPONS FUNCTIONING

1. OBJECTIVE

The objective of this Materiel Test Procedure (MTP) is to outline procedures for collecting and recording pertinent operating data for use in determining weapons functioning.

2. BACKGROUND

Proper weapons functioning is one of the primary prerequisites for successful combat operations. A malfunction that might be considered insignificant during training could be disastrous in actual combat.

The development of new and evolutionary types of weapons and ammunition, along with product improvement efforts on standard items has created a need for continuous testing to ensure that malfunctioning of weapons is detected and corrected as early as possible.

3. REQUIRED EQUIPMENT

- a. Range Facilities, as required.
- b. Ammunition, as required.
- c. Pullover Gauge or Barrel Gauge.
- d. Scratch Gauge.
- e. Stop Watches.
- f. Pertinent Technical Manuals, Weapon Record Data, and other applicable publications, as available.
- g. Gunner's Quadrant.

4. REFERENCE

- A. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- B. MTP 3-3-501, Personnel Training.

5. SCOPE

5.1 SUMMARY

This MTP describes the following tests:

a. Preparation for Tests - An evaluation of the condition of the test item prior to testing, inspection of the ammunition, safety and personnel training procedures.

b. Artillery Caliber Weapons - A determination of the cause of malfunctioning during normal firing and the effects of extreme elevation and cant on the test item functioning and recoil system performance.

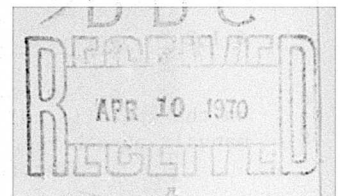
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14

MTP 3-3-510
26 November 1969

c. Automatic Weapons - A determination of the cause of malfunctioning during normal firing and the effects of extreme elevation and cant on the test item functioning and rate of firing.

5.2 LIMITATIONS

These procedures are primarily for use in evaluating the functioning of artillery caliber and automatic crew-served weapons. However, with minor changes they could be used for other weapons.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Safety

The project officer shall ensure that a safety release in accordance with Reference 4A has been received from HQ, USATECOM, and the operational limitations and specific hazards peculiar to the test item are understood before the test is started.

6.1.2 Personnel

a. Ensure the availability of test personnel who have been trained on the specific test item in accordance with pertinent technical and field manuals or other appropriate documents.

b. Ensure the availability of qualified observers.

NOTE: In most cases due to experience, training, and duty station, this will be the personnel actually using the item.

c. Ensure that adequate test recorder(s) are available to record observer data.

d. Record the following for all test personnel:

- 1) Name
- 2) Rank or grade
- 3) Military Occupational Specialty (MOS)
- 4) Training time in MOS
- 5) Experience in MOS
- 6) Duty station

6.1.3 Scheduling

Necessary arrangements should be made for collecting data on weapon functioning during all firing exercises conducted throughout the entire test period.

6.1.4 Orientation

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Orient all test personnel using the criteria of MTP 3-3-501 and the following:

- a. Objectives of the test
- b. Data desired
- c. Methods of obtaining desired data
- d. Method of analyzing and diagnosing each potential malfunction

6.1.5 Pre-test Inspection

6.1.5.1 Weapons

a. Test personnel shall inspect the entire weapon system (weapon mount, recoil system, feed system, etc.) in accordance with the instructions in pertinent technical manuals, and record the following:

- 1) Nomenclature and serial number of weapon.
- 2) Serial number of mount.
- 3) Nomenclature and serial and/or test number of vehicle on which weapon is installed, when applicable.
- 4) Location of weapon on vehicle for automatic weapons.
- 5) Number and type of rounds as recorded in the Weapon Record Data (for automatic weapons with more than one barrel record the number of rounds fired through each barrel).
- 6) Barrel measurements.

b. Qualified maintenance personnel shall inspect all weapons, mounts, recoil system, etc., in accordance with published instructions. Repairs and/or replacements should be made as required to put materiel in satisfactory condition for testing. Record all repairs or replacements made.

c. All artillery caliber weapons should be moved out of battery to their normal recoil distance, and the gun elevated and depressed to the maximum to visually determine whether there is sufficient recoil clearance at these positions. Record interferences, if any.

6.1.5.2 Ammunition

6.1.5.2.1 Artillery Caliber - Perform the following:

a. Inspect all metal ammunition cases and record the ammunition lot number and evidence of the following, if any:

- 1) Hairline cracks.
- 2) Dents.
- 3) Bulges.
- 4) Rust (steel cases).
- 5) Signs of corrosion or green film (brass cases).
- 6) Other defects that might cause a failure to extract or completely eject.

b. Inspect all non-metallic cases and record the ammunition lot

MTP 3-3-510
26 November 1969

number and evidence of the following, if any:

- 1) Dents
- 2) Bulges
- 3) Softness or discoloration due to moisture
- 4) Other indications of deterioration

c. Inspect the fixed rounds and record any indications of looseness and/or improper crimping of the case.

6.1.5.2.2 Automatic Weapons - Perform the following:

a. Inspect the ammunition cases and record the ammunition lot number and evidence of the following:

- 1) Hairline cracks.
- 2) Dents.
- 3) Bulges.
- 4) Rust (steel cases).
- 5) Signs of corrosion or green film (brass cases).
- 6) Other defects that might cause a failure to extract or completely eject.

b. Inspect belted ammunition carefully for short or long rounds and record ammunition lot number of defective ammunition.

c. Flex metal-linked ammunition to ensure that the case has not become bonded to the links by rust or corrosion.

6.2 TEST CONDUCT

NOTE: For the purpose of this document, weapons are divided into two classes. These are the automatic weapon class which includes machine guns and the artillery caliber class. For convenience in delineating test procedures for observing and recording weapons functioning data, each class will be covered separately.

6.2.1 Artillery Caliber Weapons

NOTE: Normally artillery caliber weapon functioning tests will be limited to observations made during the scheduled firing throughout the other testing phases of the weapon. This is due to the limited amount of ammunition that is usually available and the need for obtaining the greatest possible amount of data from each round.

6.2.1.1 General Functioning Tests

Observe the functioning of the test item for each round fired and perform the following for each malfunction or stoppage which occurs:

a. Record the following information:

- 1) Model and serial number of weapon.
- 2) Total number of rounds (by type) fired prior to malfunction.
- 3) Ammunition type and lot number.
- 4) Type of malfunction (e.g., failure to fire, failure to extract or eject, partial ejection, etc.).

NOTE: 1. A partial ejection should be recorded as a malfunction even though the loader can easily remove the case.
2. Cases which are ejected with such force that they damage equipment to the rear of the weapon and can become a safety hazard should also be recorded.

- 5) Elevation of weapon.
- 6) Cant of weapon.
- 7) Direction of gun with respect to the vehicle, if applicable.

b. Measure and record applicable meteorological data, including:

- 1) Temperature
- 2) Relative humidity

c. Determine if the round was the cause of the malfunction by performing the following:

- 1) Determine if the cartridge case is defective by repeating the inspection of paragraph 6.1.5.2.1.
- 2) Check rounds which require an unusual amount of force to load for size and roundness.

NOTE: These rounds should be set aside and not used in test firing.

d. If the weapon is determined to be at fault, determine the cause of the failure as prescribed in the pertinent technical manual or other appropriate document and record the following:

- 1) Identification of part(s) or subassembly(s) which malfunctioned.
- 2) Measures taken to place weapon back in operation (e.g., replacement of part, readjustment of tolerances, etc.).
- 3) Time required to place weapon back into operation.

6.2.1.2 Recoil System

a. Instrument the test item with a scratch gauge to measure the length of recoil.

NOTE: In using the scratch gauge, a coat of heavy grease on the gun barrel underneath the gauge point will facilitate recording the amount of recoil without scratching the paint or barrel.

b. Fire a minimum of 10 rounds with the gun barrel at normal eleva-

tion and no cant. Record the following:

- 1) Angle of elevation of the gun barrel.
- 2) Length of recoil as indicated by scratch gauge.
- 3) Unusual recoil cycling which could adversely effect weapon functioning.
- 4) Evidence of leaks observed in the recoil system.
- 5) If the weapon is vehicle mounted, the observed effects of recoil on the vehicle.
- 6) Difficulties, if any, encountered in firing the weapon.
- 7) For each malfunction, data collected as described in paragraph 6.2.1.1.

- c. Repeat step b with the gun barrel at a maximum and minimum elevation.
- d. Repeat steps b and c with the weapon at the maximum cant to the right and to the left and record the angle of cant.
- e. For vehicle mounted weapons repeat steps b, c and d with the weapon pointed to the rear and over the sides of the vehicle.
- f. Repeat steps b through e for each type of ammunition.

NOTE: In determining whether partial ejections and the violent ejections are actually malfunctions, it must be remembered that there are great differences between the propelling charges and resultant pressures for hypervelocity armor piercing ammunition (AP) and low velocity high explosive (HE) rounds. The recoil system must accommodate both these extremes so an occasional undesirable performance must be expected.

6.2.2 Automatic Weapons

6.2.2.1 General Functioning Tests

Observe the functioning of the test item for each round fired during all phases of testing and perform the following for each malfunction or stoppage which occurs:

- a. Record the following information:

- 1) Model and serial number of weapons.
- 2) Total number of rounds (by type) fired prior to malfunction.
- 3) Ammunition type and lot number.
- 4) Type of malfunction (e.g., failure to feed, failure to strip round from link, failure of breechblock to close, failure of round to chamber, failure to fire, failure to extract, failure to eject, inadvertent fire).

NOTE: Within the range of performance of an automatic weapon, a variation in cyclic rate (usually sluggishness) may occur or control of bursts may become erratic to the degree that delivery of fire in the desired (or selected) mode is ser-

iously impaired. Such conditions constitute improper functioning and, when severe, may be cause for suspending fire in order to adjust, clean, and lubricate, or replace a part. Accordingly, in the analysis of weapon functioning, such occurrence may be treated as if a stoppage had occurred.

- 5) Whether a stoppage could be cleared by immediate action.
- 6) Elevation of weapon.
- 7) Cant of Weapon.
- 8) Direction and velocity of weapon movement, if applicable.

b. Measure and record applicable meteorological data, including:

- 1) Temperature
- 2) Relative Humidity

c. Determine if the round was the cause of the malfunction by performing the inspection of paragraph 6.1.5.2.2.

d. If the weapon is determined to be the cause of the malfunction, determine which functional groups are malfunctioning by using procedures as prescribed in the pertinent technical manual or other appropriate document and record the following:

- 1) General cleanliness of weapon.
- 2) Identification of malfunctioning functional group(s) (e.g., backplate groups, barrel extension groups, jacket assembly groups, etc.).

NOTE: On some weapons certain components must be replaced after a specified number of rounds, extreme care must be taken to ensure that this is done so as not to invalidate results of the test.

- 3) Measures taken to place weapon back in operation (e.g., replacement of part, readjustment of tolerances, etc.).
- 4) Time required to place weapon back in operation.

6.2.2.2 Effects of Weapon Attitude

a. Mount the weapon on a mount which will permit varying the angle of cant and elevation to the maximum limits.

b. Fire a minimum of 100 rounds with weapon at normal elevation and no cant. Record the following:

- 1) Angle of elevation.
- 2) Difficulties encountered in feeding, loading, firing, extracting, etc.
- 3) For each malfunction, data collected as described in paragraph 6.2.2.1.

c. Repeat step b for a maximum elevation and 5 equally spaced inter-

MTP 3-3-510
26 November 1969

vals between maximum and normal elevation and equal intervals between minimum and normal elevation. Record indications of change in rate of fire.

d. Repeat steps b and c with the weapon canted the maximum to the right and to the left and at intervals as specified by the test director. Record the angle of cant used each time.

e. With the weapon at normal elevation and no cant begin firing and then rapidly elevate the weapon to the maximum elevation. Observe and record the following:

- 1) Apparent changes in the rate of fire.
- 2) Difficulties encountered in feeding, firing, extracting, ejecting, etc.

f. Repeat step e for depression to minimum elevation.

6.2.2.3 Rate of Fire

Verify the cyclic rate of fire (rounds fixed per minute) by performing the following:

a. Fire a specific number of rounds at the maximum allowable firing rate and measure the time required.

b. Record the following:

- 1) Total number of rounds fired by weapon prior to test
- 2) Number of test rounds fired
- 3) Time required to fire test rounds

c. Repeat steps a and b at varying stages of weapon life as specified by the test director to determine the effect, if any, that wear has on the cyclic rate of fire.

6.3 TEST DATA

6.3.1 Preparation For Test

6.3.1.1 Personnel

Record the following for all test personnel:

- a. Name
- b. Rank or grade
- c. MOS
- d. Training time in MOS
- e. Experience in MOS
- f. Duty station

6.3.1.2 Pre-test Inspection

6.3.1.2.1 Weapons -

Record the following:

- a. Nomenclature and serial number of weapon.
- b. Serial number of mount.
- c. Nomenclature and serial and/or test number of vehicle in which weapon is installed, when applicable.
- d. Location of weapon on vehicle, for automatic weapons.
- e. Number and type of rounds which have been fired as recorded in the Weapon Record Data.
- f. Barrel measurements.
- g. Repairs and/or replacements made.
- h. Any points of possible interference between gun and other components as measured when weapon is out of battery and elevated and depressed to the maximum for artillery weapon.

6.3.1.2.2 Ammunition -

Record the following:

a. For artillery caliber:

- 1) Lot number
- 2) Evidence of the following for metallic cases:
 - a) Hairline cracks.
 - b) Dents.
 - c) Bulges.
 - d) Rust (steel cases).
 - e) Signs of corrosion or green film (brass cases).
 - f) Other defects which might cause a failure to extract a completely eject.
- 3) Evidence of the following for non-metallic cases:
 - a) Dents
 - b) Bulges
 - c) Softness or discoloration due to moisture
 - d) Other indications of deterioration

4) Evidence of loose projectiles and/or improper crimping

b. For automatic weapons:

- 1) Lot number
- 2) Evidence of the following:
 - a) Hairline cracks.
 - b) Dents.
 - c) Bulges.
 - d) Rust (steel cases).

MTP 3-3-510
26 November 1969

- e) Signs of corrosion or green film (brass cases).
- f) Other defects that might cause a failure to extract or completely eject.
- g) Short and/or long rounds.

3) Evidence of rust or corrosion of metal-linked ammunition

6.3.2 Test Conduct

6.3.2.1 Artillery Caliber Weapons

6.3.2.1.1 General Functioning Tests -

Record the following:

- a. Model and serial number of weapon.
- b. Total number of rounds (by type) fired prior to malfunction.
- c. Ammunition type and lot number.
- d. Type of malfunction (e.g., failure to fire, failure to extract or eject, partial ejection, etc.).
- e. Elevation of weapon, in mils.
- f. Cant of weapon in degrees.
- g. Direction of gun with respect to the vehicle, if applicable.
- h. Meteorological data, including:
 - 1) Temperature in °F.
 - 2) Relative humidity, in percent
- i. For rounds which malfunction:
 - 1) Inspection data collected as described in paragraph 6.1.5.2.1.
 - 2) For rounds which are difficult to load:
 - a) Diameter
 - b) Evidence of out of roundness
- j. For the weapon:
 - 1) Identification of part(s) or subassembly(s) which malfunction.
 - 2) Measures taken to place weapon back into operation (e.g., replacement of part, readjustment of tolerances, etc.).
 - 3) Time required to place weapon back in operation.

6.3.2.1.2 Recoil System -

Record the following:

- a. Gun elevation in mils
- b. Angle of cant in degrees
- c. Direction of gun with respect to vehicle, if applicable
- d. Type of ammunition used

- e. Length of recoil, in inches
- f. Evidence of unusual recoil cycle
- g. Evidence of leaks in recoil system
- h. Effects of recoil on the vehicle, if applicable
- i. Difficulties experienced in firing the weapon
- j. Malfunction data collected as described in paragraph 6.2.1.1

6.3.2.2 Automatic Weapons

6.3.2.2.1 General Functioning Tests -

Record the following:

- a. Model and serial number of weapon.
- b. Total number of rounds (by type) fired prior to malfunction.
- c. Ammunition type and lot number.
- d. Type of malfunction (e.g., failure to feed, failure to strip round from link, failure of breechblock to close, failure of round to chamber, etc.).
- e. Whether stoppages could be cleared by immediate action.
- f. Elevation of weapon in mils.
- g. Cant of weapon in degrees.
- h. Direction and velocity of weapon movement, if applicable.
- i. Meteorological data, including:
 - 1) Temperature, in °F.
 - 2) Relative humidity in percent
- j. For the round, inspection data collected as described in paragraph 6.1.5.2.2.
- k. For the weapon:
 - 1) General cleanliness of weapon.
 - 2) Identification of malfunctioning functional group(s) (e.g., backplate group, barrel extension group, jacket assembly group, etc.).
 - 3) Measures taken to place weapon back in operation.
 - 4) Time required to place weapon back in operation.

6.3.2.2.2 Effects of Weapon Attitude -

Record the following:

- a. For fixed firing attitudes:
 - 1) Angle of elevation in mils.
 - 2) Angle of cant in degrees.
 - 3) Difficulties in feeding, loading, firing, extracting, etc.
 - 4) For each malfunction, data collected as described in paragraph 6.2.2.1.
 - 5) Indications of change in the rate of fire due to change in the weapon elevation.

MTP 3-3-510
26 November 1969

b. For elevation and depression tests:

- 1) Direction of movement (elevation or depression).
- 2) Apparent changes in the rate of fire.
- 3) Difficulties encountered in feeding, firing, extracting, ejecting, etc.).

6.3.2.2.3 Rate of Fire -

Record the following:

- a. Number of rounds fired prior to test
- b. Number of test rounds fired
- c. Time required to fire test rounds, in seconds

6.4 DATA REDUCTION AND PRESENTATION

Consolidate all test data and present in graph or chart form for easy comparison with test criteria or the results of test of similar type weapons. Compute the rate of fire for automatic weapons as follows:

$$\text{Rate of fire per minute} = \frac{60}{t} \times R$$

where: R = the number of test rounds fired
t = time to fire test rounds in seconds

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